ACCEPTANCE TESTING PROCEDURE

1. PURPOSE

The purpose of this document is to provide for a standardized process for testing new controllers. It sets forth the testing sequence and acceptance criteria for selection of a new controller platform(s). The testing process will be used to determine controllers that meet, significantly meet or exceed requirements as set forth in the specifications.

It is the intent of the City to use the testing process described herein to identify one or more complete controller package(s), consisting of both hardware and software, for procurement and installation within the City. If a submitted controller package is identified for procurement, the vendor submitting the package shall be fully responsible for furnishing the complete package and providing support during the period of the contract.

Changes to the controller hardware and/or software shall not be permitted after a controller has been tested and selected. If the vendor creates a newer version of the controller (hardware or software) after testing, the vendor may propose to provide the newer version. In the proposal, the vendor must document all the changes in the newer version of the controller in comparison to the tested and approved version of the controller. The City will have the sole discretion to accept or reject the entire or part of the proposal.

2. TESTING PROCESS

From the responses provided by the Vendor in FORM **A1 CONTROLLER SUBMITTAL and FORM A2 SPECIFICATIONS COMPLIANCE FORM (Required with submittal, see Appendix A)**, the specifications will be verified and any deviations from the responses will be noted.

The shortlisted controllers (based on the evaluation of the submittal documentation) will be bench tested at the City's Traffic Signal Shop. The setup for bench testing will be recorded on **Form C1**. The bench testing will be performed in two phases. During the first phase, basic controller functions will be evaluated. The second phase will include testing of advanced controller functions, such as peer-to-peer communication, transit signal priority and any proprietary functions of the controller. **A REPRESENTATIVE OF THE CONTROLLER VENDOR MAY BE PRESENT DURING THE BENCH TESTING.**

All controllers that are successfully bench tested will be selected for field testing. Successful bench testing indicates that the controller is successfully tested for all functions and operations as indicated in the testing process and documented in the Phase 1 and Phase 2 bench testing forms (**Form C2** and **Form C3**). The field

testing will be performed over a period of 90 calendar days with the monitoring of the operations from the TransSuite central traffic management system.

3.   TESTING SETUP

3.1 Bench Testing

PHASE 1 BENCH TESTING will be used to verify the compliance of the controller with the following sections of the ATC controller specification as listed below (refer to Section V, Scope of Work):

Bench testing of the controllers will be performed at the City of Phoenix Traffic Signal Shop. The controller will be installed in a City standard NEMA TS-2 Type 1 cabinet. All cabinet components – load switches, malfunction monitoring unit (MMU), power supply (PS), detector cards, bus interface units (BIUs), relays and preemption cards will be provided by the City in the cabinet according to City specifications. The cabinet and the MMU will be setup for operating 8-vehicle phases, 4-pedestrian phases, and 4 overlaps.

A communications switch providing connectivity to TransSuite will be installed in the cabinet and connected to the controller. The cabinet outputs will be wired to a light board to display eight vehicle signals and four pedestrian signals. The cabinet will be powered by connecting it to a 120 Volts Alternate Current (VAC) power source. The startup process for the equipment will be observed. If any operational anomaly or discrepancy is observed, the cabinet will be powered off and the appropriate connections will be checked. The cabinet will be powered on again. Once satisfactory start up process is observed, the controller will be loaded with an 8-Phase Standard Test Program that will be used for testing the controller for Phase 1 Bench Testing for verifying the general functionalities of the controller.

After completion of the testing for the 8-Phase traffic signal operation, the cabinet will be rewired for the operation of a Pedestrian Hybrid Beacon (PHB). The outputs from the cabinet will be connected to a light board to output the pedestrian crossing signals and the vehicular signals for a PHB.

- Item 4. – Minimum Requirements
- Item 5. – General Requirements
- Item 6. – Hardware Requirements
- Item 7. – Operating System Requirements
- Item 8. – Intersection Signal Control Software Requirements
- Item 8.1. – General Software Requirement
- Item 8.2. – Basic Timing Parameters
- Item 8.3. – Coordination
- Item 8.4. – Detector Inputs
- Item 8.5. – Pedestrian Overlaps

- Item 8.6. – Preemption
- Item 8.9. –Time Base Schedule
- Item 9. – Access and Security Level Requirements
- Item 10. – Alarms Requirements
- Item 11. – Communications Requirements

The results of the testing will be recorded in the PHASE 1 BENCH TESTING (FORM C2).

PHASE 2 BENCH TESTING will commence after the completion of Phase 1 testing. Phase 2 will test the advanced controller features of the cabinet. It should be noted that it is not necessary for a controller to have all these features; only the specific features of a controller will be tested. The features that will be tested, along with the section of the specifications these references are listed below.

- Section 8.7 – Transit Signal Priority
- Section 8.8 – Peer-to-Peer Communication
- Section 12 – Preferred Features

For Phase 2 testing, three cabinets will be setup to operate 8 vehicle phases, 4 pedestrian phases, 2 transit phases and 2 blankout signs. The setup of the cabinet will be similar to a typical 8-phase signalized LRT intersection within COP. The three cabinets will be connected using a daisy-chain network topology with the controllers connected to TransSuite. The cabinet outputs will be wired to a light board display with vehicle signals, pedestrian signals and the blankout signs. **The results of the testing will be recorded in the PHASE 2 BENCH TESTING (FORM C3).**

3.2 Field Testing

The field-tested controllers will be installed in three adjacent NEMA TS-2 Type 1 cabinets within the City. To verify the operation of the Transit Signal Priority operation and the peer-to- peer communication, the intersections selected for field testing will be existing LRT intersections. The databases for the three controllers will be configured to match the existing databases for these intersections.

Prior to installation of the controllers in the field cabinet, the configured controllers with the intersection datasets will be tested in the Traffic Signal Shop using the cabinet setup for bench testing for at least 48 hours without any failures noted. Any failures noted during the 48 hours of testing the controllers will require the restart of the testing and will need to be completed in an additional 48 hours, without any failures. Prior to the installation of the controllers in the field cabinets, COP officials will inform Valley Metro of the testing. This will allow Valley Metro LRT operators to observe any anomalies in operation at the intersections and report to the City. The City will monitor the operation of the signals at these

intersections from TransSuite. **The results of the testing will be recorded in the PHASE 2 FIELD TESTING (FORM C4)**.

4. Acceptance Criteria

For controllers being tested, standard NEMA functions such as phase, ring, preemption, detection, time base and other proprietary controller functions will be considered to perform acceptably if the outputs from these functions perform within acceptable tolerances specified in the NEMA TS-2 specifications and as per the City's Advanced Traffic Controller specifications. If any of these functions produce non-standard NEMA form outputs or incorrect load switch indications, those functions will be deemed to have failed to meet the acceptance criteria for those functions.

Any operational or performance issues identified during the bench testing or the field testing of the controllers will be communicated to the representative of the vendor. Any operational issues that have an impact on the safe operation of the intersection will be deemed a critical issue. If a critical issue is discovered during the bench or field testing of the controller, the testing will be stopped, and the vendor notified of the issue. The vendor will be provided a period of 30 calendar days from the day of the failure to provide a solution to fix the issue for the first critical issue and 15 calendar days for subsequent critical issues identified. If the vendor fails to provide a workable solution to fix a critical issue within the allotted timeframe, the controller will be deemed to have failed the testing and no further testing of the controller will be performed. If greater than three critical issues are encountered during the testing, the controller will be deemed to have failed the testing. The determination whether an issue will be considered critical will be the sole discretion of the City. Provided below is a partial listing of some issues that will be considered critical.

- Controller puts the intersection into flash without the MMU detecting any conflicts or controller flash input being activated.
- Controller does not put a call for an actuated vehicle, transit or pedestrian phase even though a detection call is registered.
- Controller re-starts on its own without any related input.
- Controller provides less clearance time than the programmed values.

During the testing process, controller operations will be monitored and logged from TransSuite. Controllers that are fully integrated with TransSuite and can be easily monitored will be preferred over those that are not. During field testing, the ease of use of the controller by City's Street Transportation Department staff will be evaluated and rated.

The controller operation should be able to clearly distinguish between essential and non-essential items and prioritize essential functions over non-essential functions. If a non-essential function fails, it should not put the controller into flash but rather activate an alarm that can be monitored from TransSuite. An example would be if the controller Ethernet port is faced with an ARP storm, it should shut-off that port and not produce anomalies in the outputs from the controller.

5. TEST FORMS

Appendix C contains the following test forms:

- **FORM C1 – CABINET/CONTROLLER SETUP FORM**
- **FORM C2 – PHASE 1 BENCH TEST FORM**
- **FORM C3 – PHASE 2 BENCH TEST FORM**
- **FORM C4 – FIELD TEST LOG**